

SECTION 4.1

NUMBER 13

4.1. 13 Let $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j}$.
Find $\vec{a} \times \vec{b}$.

Solution

We have

$$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -1 & 3 \\ 1 & 2 & 0 \end{vmatrix}$$

$$= + \begin{vmatrix} -1 & 3 \\ 2 & 0 \end{vmatrix} \hat{i} - \begin{vmatrix} 2 & 3 \\ 1 & 0 \end{vmatrix} \hat{j} + \begin{vmatrix} 2 & -1 \\ 1 & 2 \end{vmatrix} \hat{k}$$

$$= \left((-1)(0) - (3)(2) \right) \hat{i} - \left((2)(0) - (3)(1) \right) \hat{j} + \left((2)(2) - (-1)(1) \right) \hat{k}$$

$$= \boxed{-6\hat{i} + 3\hat{j} + 5\hat{k}} \quad \square$$

NOTE! Notice

$$\begin{aligned} (\vec{a} \times \vec{b}) \cdot \vec{a} &= [-6, 3, 5] \cdot [2, -1, 3] \\ &= (-6)(2) + (3)(-1) + (5)(3) \\ &= -12 - 3 + 15 = 0. \end{aligned}$$

∴ $\vec{a} \times \vec{b} \perp \vec{a}$.